IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

David N. Nichols, et al

AN IMAGE SENSOR WITH TRANSPARENT TRANSITOR GATES

Serial No. 10/629,885

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Examiner: Gebremariam, Samuel A.

I hereby certify that this correspondence is being deposited today with the United States Postal Service as first class mail in an envelope addressed to Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Lois A. Massar

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Dec. 8, 2004

Date

Commissioner for Patents
P.O. Box 1450
Alexandria, VA. 22313-1450

Sir:

DECLARATION UNDER 37 CFR 1.132

I, David N. Nichols, a co-inventor of the subject application hereby declare that:

1. I have a Ph.D. in Physics from Purdue University 1981; M.S. in Physics from Purdue University 1977; and a B.S in Physics and Mathematics from SUNY, College at Fredonia, 1975. I have been active in research & development of image sensors for 23 years. I have over 40 publications, technical reports and presentations and am the inventor or co-inventor of 4 US Patents and several applications.

2. Integrated circuit technology uses the properties of semiconductors to form transistors, resistors, and diodes for use as switches, amplifiers, capacitors, etc. These transistors and capacitors may use gate electrodes upon the semiconductor substrate to control the voltage, charge, or current within the semiconductor material. Most semiconductor circuits are not used for image sensing, but are used for a large variety of electronic systems such as computers, stereo equipment, etc. These semiconductor circuits are protected from light because light creates additional electrical charge in the semiconductor that may interfere with device operation. Therefore most integrated circuits include an

outer assembly made of opaque substances (such as black plastic materials or black ceramics) to prevent light from interacting with the circuit elements.

3. Solid-state image sensors are often based on integrated circuit technology. Solid-state image sensors take advantage of this light-induced charge generation to create an electrical signal that represents the scene focused on the sensor. These sensors are composed of light-sensitive regions in each pixel that converts light into an electrical signal, and other regions that then process that signal or are used to control the image capture. These latter regions are sometimes shielded from light to prevent degradation of the signal by additional charge generated from light.

4. To improve the photoresponse in the light-capturing regions of image sensors, transparent materials are often used. Materials such as ITO (indium-tin oxide) are used for the gate electrode within the light-sensitive regions of the pixel because less-transparent materials either reflect or absorb light, thereby preventing some of the light from reaching the semiconductor. The use of transparent electrodes in the light-capturing region of the pixel image is well known. Matsumoto et al., in US patent 4,878,120 describe the use of a transparent electrode specifically in the light-sensitive region of the pixel (column 6, lines 1-9). In the same patent, Matsumoto et al. also describe formation of source and drain electrodes of transparent material "to increase the light receiving efficiency" within the light-sensitive region of the pixel (column 11, lines 24-33). In US patent 4,589,027 by Nakamura and Matsumoto, the inventor also discloses (column 2, lines19-34) that the gate electrode for the optically active region is transparent to incident light. Later in the same specification, the inventors state (col. 3, lines 1-4) "It should be further noted that except for the light receiving gate electrode 9 the image sensor is fully covered with a light shielding film 11." Regions that are not intended for light capture often are covered to prevent light from interacting with the semiconductor.

5. Therefore, the use of a transparent gate electrode for the image-capturing region of the pixel is well known in the art of solid-state image sensors. However, in regions outside of the image-capturing region of the pixel, the use of transparent elements is not disclosed. In fact, these regions are often shielded so that any stray light does not degrade the sensor performance. Therefore, the use of a highly transparent material such as ITO for the gate electrode for the output amplifier as described in the subject application is neither conventional in the art nor is it obvious from the disclosure of the prior art.

6. All statements made herein of his own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Respectfully Submitted,

David N Nichols

David N. Nichols